

Practitioner's Docket No.: 791_151

PATENT

475

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the application of: Yukihisa TAKEUCHI and Nobuo TAKAHASHI

Ser. No.: 09/888,048

Group Art Unit: Not Assigned

Filed: June 22, 2001

Examiner: Not Assigned

Confirmation No.: 6969

For: CELL DRIVING TYPE ACTUATOR AND METHOD FOR MANUFACTURING THE SAME



Assistant Commissioner for Patents
Washington, DC 20231

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail addressed to Assistant Commissioner for Patents, Washington D.C. 20231 on January 22, 2002.

Elizabeth A. VanAntwerp
Elizabeth A. VanAntwerp

PRELIMINARY AMENDMENT

Sir:

Prior to examination, Applicants wish to amend the subject application as follows:

In the Specification:

Please replace paragraph [0011] with the following rewritten paragraph:

[0011] The present invention has been completed in view of the above mentioned problems. That is, the theme to be solved by the invention is to provide a piezoelectric/electrostrictive actuator to which a high-temperature heating process can be applied, which ensures mass production at a low cost, which can be driven with a high-strength electric field, slit portions may form cells defined by the lines inclusive of lines other than the straight line with cell width of 60 μm or less, and in which the cells have a high aspect ratio, thereby enabling a greater displacement to be realized with a weaker electric field, and also to provide a method for manufacturing such an actuator.

After making many investigations regarding the piezoelectric/electrostrictive actuator and the method for manufacturing the same, it is found that the above-mentioned theme can be dissolved by the piezoelectric/electrostrictive actuator and by the method for manufacturing it as shown below.

Please replace paragraph [0014] with the following rewritten paragraph:

[0014] In the cell driving type actuator according to the invention, moreover, it is preferable that the surface roughness R_t of the wall surfaces of piezoelectric/electrostrictive elements where the elements face one another and form a cell is approximately $10\ \mu\text{m}$ or less. It is preferable that the width of the comb-like piezoelectric/electrostrictive elements varies from the recess to the front end of the comb teeth, and it is also preferable that the spacings between the adjacent piezoelectric/electrostrictive elements for forming a cell, or, the spacings between the cell and its adjacent cell, the width of a cell defined by two sets of piezoelectric/electrostrictive elements being present adjacent each other, and, the space defined by a pair of the cells and its adjacent cell may be different from pair to pair. That is, at least two different lengths may exist as for both the width and the space, respectively.

Please replace paragraph [0048] with the following rewritten paragraph:

[0048] As above-mentioned in detail, the present invention solves the first to eighth problems in the conventional art, and offers a cell driving type actuator and a method for manufacturing the actuator, wherein a heating process at a high temperature can be applied; mass production at low cost is possible; slit portions may form cells defined by the lines inclusive of lines other than the straight line, a width of $60\ \mu\text{m}$ or less, and a high aspect ratio; the cells can be activated with a higher electric field strength; and the actuator is based

on the principle of the piezoelectric/electrostrictive effect where a greater displacement can be obtained with a smaller electric field strength.

In the Claims:

Please cancel claim 11.

Please add new claim 14 as follows:

14. (NEW) A use of a cell driving type actuator as a liquid discharging device:

said actuator wherein a plurality of piezoelectric/electrostrictive elements are arranged in alignment like teeth of a comb on a base plate and said actuator is a piezoelectric/electrostrictive actuator being driven by means of dislocation of piezoelectric/electrostrictive elements,

wherein each of cells is formed independently from its adjacent cells by closing respective planes being positioned between two adjacent piezoelectric/electrostrictive elements and facing the base plate with respective cover plates and wherein, each of cells is used as a liquid pressurizing chamber, and said piezoelectric/electrostrictive elements are displaced by applying a driving electric field thereto in the same direction as the polarization field of said piezoelectric/electrostrictive elements, thus deforming said liquid chamber, thereby enabling a liquid filled in said liquid chamber to be discharged in the direction of the front end of the comb teeth.

REMARKS

Prior to examination, Applicants respectfully request entry of this Amendment in which the specification has been amended to correct minor informalities.

Claims 1-10, and 12-14 are pending herein. Claim 11 has been canceled in favor of new claim 14. No new matter has been added. Applicants believe the case is now in condition for examination.

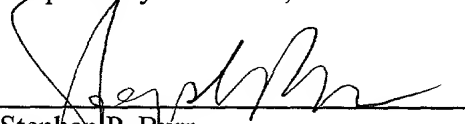
Attached hereto as pages 5 and 6 is a marked-up version of the changes made to the specification by the current Amendment. The attached pages are captioned "VERSION WITH MARKINGS TO SHOW CHANGES MADE."

If the Examiner believes that contact with applicants' attorney would be advantageous toward the disposition of this case, he is herein requested to call applicants' attorney at the phone number noted below.

The Commissioner is hereby authorized to charge any additional fees associated with this communication or credit any overpayment to Deposit Account No. 50-1446.

January 22, 2002
Date

Respectfully submitted,


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VERSION WITH MARKINGS TO SHOW CHANGES MADE**In the Specification:**

Paragraph [0011] has been amended as follows:

[0011] The present invention has been completed in view of the above mentioned problems. That is, the theme to be solved by the invention is to provide a piezoelectric/electrostrictive actuator to which a high-temperature heating process can be applied, which ensures mass production at a low cost, which can be driven with a high-strength electric field, ~~in which slit portions have~~ may form cells defined by the lines inclusive of lines of other than a straight line shape with cell width of 60 μm or less, and in which the cells have a high aspect ratio, thereby enabling a greater displacement to be realized with a weaker electric field, and also to provide a method for manufacturing such an actuator.

After making many investigations regarding the piezoelectric/electrostrictive actuator and the method for manufacturing the same, it is found that the above-mentioned theme can be dissolved by the piezoelectric/electrostrictive actuator and by the method for manufacturing it as shown below.

Paragraph [0014] has been amended as follows:

[0014] In the cell driving type actuator according to the invention, moreover, it is preferable that the surface roughness R_t of the wall surfaces of piezoelectric/electrostrictive elements where the elements face one another and form a cell is approximately 10 μm or less. It is preferable that the width of the comb-like piezoelectric/electrostrictive elements varies from the recess to the front end of the comb teeth, and it is also preferable that the spacings between the adjacent piezoelectric/electrostrictive elements for forming a cell, or, the spacings between the cell and its adjacent cell, ~~may have at least two different distances~~ the width of a cell defined by two sets of piezoelectric/electrostrictive elements being present adjacent

VERSION WITH MARKINGS TO SHOW CHANGES MADE

each other, and, the space defined by a pair of the cells and its adjacent cell may be different from pair to pair. That is, at least two different lengths may exist as for both the width and the space, respectively.

Paragraph [0048] has been amended as follows:

[0048] As above-mentioned in detail, the present invention solves the first to eighth problems in the conventional art, and offers a cell driving type actuator and a method for manufacturing the actuator, wherein a heating process at a high temperature can be applied; mass production at low cost is possible; the slit portions may form each have ~~a cell~~ cells defined by the lines inclusive of lines ~~which has a shape other than a the~~ straight one line, a width of 60 μm or less, and a high aspect ratio; the cells can be activated with a higher electric field strength; and the actuator is based on the principle of the piezoelectric/electrostrictive effect where a greater displacement can be obtained with a smaller electric field strength.